

# Factors Affecting Commercial Bank Lending to Agriculture

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## *Abstract*

A tobit econometric procedure was used to examine the effect of selected demand and supply factors on nonreal estate agricultural lending by commercial banks in Texas. Results show that banks have reduced their agricultural loan portfolios in response to increased use of interest sensitive deposits after deregulation. Moreover, almost half of this decrease came from banks that stopped making agricultural loans. Also, results show that banks affiliated with multi-bank holding companies lend less money to agriculture relative to their assets than do independent banks.

**Key Words:** agricultural lending, commercial banks, deregulation, tobit

Commercial banks have traditionally played an important role in financing agriculture. Their commitment to agriculture, however, fluctuates. For example, between 1968 and 1987 their market share in nonreal estate farm lending in the U.S. ranged from a high of 66.8 percent (9.7 billion dollars) in 1968, to a low of 47.3 percent (32.8 billion dollars) in 1981, closing at 53.1 percent in 1987 (Walraven and Rosine). The fluctuation in the market share is a combination of the adjustment in the volume of funds lent by banks to the agriculture sector and the adjustment in the number of banks lending to the agriculture sector. In Texas, the proportion of banks with zero agricultural loans outstanding increased from 16.6 percent in 1968 to 35.5 percent in 1987. Between 1980 and 1987, 91 commercial banks, which had been active agricultural lenders in this period, had zero nonreal estate agricultural loans outstanding in 1987. Many factors have led to these fluctuations in agricultural lending.

It is expected that recent deregulation of commercial banks has affected agricultural lending. Since the passage of the Depository Institutions Deregulation and Monetary Control Act of 1980

(particularly with the elimination of interest rate ceilings -- commonly known as regulation Q) banks have increased their competitiveness in acquiring loanable funds, mainly in form of time deposits (Bundt and Schweitzer; Waldrop; Keely and Zimmermann). However, these time deposits are associated with higher and more variable costs that increase the overall risk of the bank operation. Moreover, changes in the type and characteristics of a bank's loanable funds can elicit a realignment of the bank's asset portfolio to reflect the new composition of its liabilities.

The competition for loanable funds has an effect on the cost and availability of loan funds to agricultural borrowers. Borrowing costs go up as lenders attempt to transfer some of these higher costs incurred in acquiring funds to borrowers. Loan funds to agricultural borrowers may be curtailed, for example, as banks seek to match their interest rate sensitive liabilities with interest rate sensitive, nonloan assets. Banks might increase security requirements, or decrease the term of the loan. Banks might also opt to increase the supervision of the loans to increase performance.

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However, because increased supervision is costly to the bank, loans may only be extended to those borrowers with a more than "usual" likelihood of repayment, thus excluding many potential farm borrowers.

A tobit econometric procedure was used in this study to examine the effects of selected demand and supply factors on agricultural lending. In particular, the impact that increased commercial bank reliance on the interest sensitive deposits after deregulation has on funds that banks allocate to agriculture relative to other investment opportunities was examined. Also, independent banks were compared to multi-bank holding company (MBHC) affiliates to determine the impact of bank organization on the share of agricultural loans in their asset portfolios.

There were 1053 Texas banks included in this study. Each of these banks was in business before deregulation (1978) and after deregulation (1987). In 1978, 7.3 percent and 25.8 percent of the rural and urban banks were MBHC affiliates, respectively. By 1987, 24.3 percent and 56.9 percent of the rural and urban banks were MBHC affiliates, respectively. Thus, it is important to study the impact this move toward MBHC organization has on agricultural lending. Although the data used in this study are unique to Texas, inferences drawn can be extended to commercial banks in the U.S.

## Model Development

### *Tobit Procedure*

As noted above, several banks have eliminated agricultural loans from their portfolios. Therefore, an econometric analysis of an uncensored sample of banks with agricultural loans as the dependent variable would have several zero values. In other words, the dependent variable is part qualitative (to lend or not to lend) and part quantitative (the amount lent). The analysis of such a limited dependent variable is called tobit analysis. This technique is designed to study models with a dependent variable having the property that many observations take on a single value (as in zero dollars lent for agriculture), with the remaining observations following the usual characteristic of a continuous variable (dollars lent to agriculture). It

has received wide application to such problems as the study of automobile purchases, models of labor supply, and household purchase of fresh vegetables.<sup>1</sup>

In his pioneering work, Tobin analyzed household expenditure on durable goods as a function of income and other variables. He noted the distortion in the data resulting from the fact that many households did not purchase a durable good during the year of survey, with the possible explanation that because expenditures on durable goods are not continuous, purchases are not made until the "desire" to buy the good exceeds a certain level. However, desires cannot be observed, only expenditures, and those will be nonzero only if the good is purchased. "Negative" expenditures, corresponding to various levels of desire below the threshold level, cannot be observed, and all households with no purchases are recorded as showing zero expenditure, with no distinction made between households who were close to buying the good and those who had very little desire to do so.<sup>2</sup>

The same is true with commercial banks. There is a certain threshold below which a bank would not effect an agricultural loan transaction (or any loan transaction for that matter), although there would be variations between different borrowers and lenders reflecting transaction costs, risks, etc. Lending is not done until the "desire" to lend exceeds a certain level. Desires, however, cannot be observed. "Negative loans," corresponding to various levels of desire below this threshold level are recorded as zero agricultural loans, with no distinction made between commercial banks that are close to lending to agriculture and those that have very little desire to do so. Previous research has circumvented the problem of limited dependent variables by excluding banks with zero agricultural loans when investigating factors affecting agricultural lending. Data samples have been limited to agricultural banks with existing agricultural loan portfolios (e.g., Barry and Pepper). This omission, however, creates sample selection bias (Heckman, 1979). Rather than delete banks with zero agricultural loans outstanding from the sample, tobit analysis is used to account for this information and to adequately portray the full range of commercial bank behavior (Tobin).

To understand this behavior, it is important to note that the changes in commercial bank lending

to the agricultural sector involve two types of adjustments: a) changes in the number of banks lending to the agricultural sector, and b) changes in the number and size of agricultural loans made by commercial banks already lending to agriculture. The time-series observations on the changes in total agricultural lending reflect both types of adjustment. However, it is impossible to estimate the separate types of adjustment from aggregate time-series data based on average bank lending to the agricultural sector (Thraen, et al.). Cross-sectional data, on the other hand, include observations on individual banks -- some of which are agricultural lenders, and others are not. One could estimate the quantity adjustment coefficients by exclusion of those banks that were not lenders to agriculture at the time of the survey. However, it is also possible to estimate both the lending volume adjustments of commercial banks already lending to agriculture, and the lending volume adjustments due to the entry or exit of banks by using the tobit estimation procedure.

### The Theoretical Model

Let

$$Y = X\beta + \varepsilon \quad (1)$$

be a regression equation for which all basic assumptions are satisfied. For commercial banks that made agricultural loans,  $Y$  is equal to the actual agricultural loans made. For those banks that did not,  $Y$  represents an index of the "desire" to make agricultural loans. The  $X$  matrix is a set of factors thought to affect  $Y$ . The  $\beta$  is a conformably defined parameter vector, and  $\varepsilon$  represents the stochastic disturbance term of the regression.

The value of  $Y$  cannot be observed when loans are not made. Thus, instead of using  $Y$ ,  $Y^a$  is used and is defined as

$$\begin{aligned} Y^a &= Y \quad \text{if } Y > 0 \\ Y^a &= 0 \quad \text{if } Y \leq 0 \end{aligned} \quad (2)$$

The new equation is

$$Y^a = X\beta + \varepsilon^a \quad (3)$$

where  $Y^a$  is truncated at zero and  $\varepsilon^a$  is truncated at  $-X\beta$ . This further implies that the lower tail of the distribution of  $Y^a$  (and thus of  $\varepsilon^a$ ) is cut off and the probabilities are piled up at the cut-off point. Consequently, the mean of  $Y^a$  is different from that of  $Y$ , and the mean of  $\varepsilon^a$  is different from that of  $\varepsilon$  which is zero. This is true whether the points for which  $Y^a$  equal zero are included or not included in the sample. Therefore, limiting the range of the values of the dependent variable leads to a nonzero mean of the disturbance and the biasness and inconsistency of the least squares estimators.

Equation (3) will be estimated using the tobit procedure. The  $\beta$  parameters will be estimated using the maximum likelihood method (assuming normality of the disturbance term). This procedure assures the large-sample properties of consistency and asymptotic normality of the estimated coefficients so that conventional tests of significance are applicable.

Following McDonald and Moffit, different elasticities, evaluated at the means, can be computed as follows:

$$\eta E[Y^a] = \frac{\partial E[Y^a]}{\partial X} \frac{X}{E[Y^a]}, \quad (4)$$

$$\eta E[Y^*] = \frac{\partial E[Y^*]}{\partial X} \frac{X}{E[Y^*]}, \quad \text{and} \quad (5)$$

$$\eta F(z) = \frac{\partial F(z)}{\partial X} \frac{X}{F(z)}. \quad (6)$$

where  $\eta E[Y^a]$  is the elasticity of the unconditional expected value of agricultural lending,

$\eta E[Y^*]$  is the elasticity of the conditional expected value of agricultural lending,

$\eta F(z)$  is the elasticity of the probability of making agricultural loans,

$F(z)$  denotes the cumulative standard normal distribution function, and

$E[Y^*]$  is the conditional expected value of  $Y$ .

It can be shown that the sum of equations (5) and (6) is equal to equation (4) (McDonald and Moffit). In other words, the unconditional elasticity of making agricultural loans can be broken down into its component parts: a) the elasticity of making agricultural loans, for current lenders to agriculture, and b) the elasticity of the probability of making agricultural loans. By looking at the two components, one can find out which component reacts most to changes in the explanatory variables. Thus, besides the usual parameter estimates, the tobit procedure provides these elasticities that serve as a measure of the impact of changes in an independent variable on agricultural lending, not just for current agricultural lenders, but for those that would quit or enter agricultural lending as well.

## Variable Description

### *The Regressand*

The model regressand,  $Y^*$ , was defined as the ratio of outstanding nonreal estate agricultural loans to total bank assets for each commercial bank. Banks have different investment options, including agricultural lending. Using total assets as the denominator shows the relative importance of agricultural loans in the bank's investment program by recognizing the nonloan investment options available to a bank (e.g., government securities) that compete with agricultural loans for investable funds. This ratio increases/decreases as more funds are moved in/out of agriculture relative to other investment opportunities. Farm real estate loans were excluded from the study because commercial banks, historically, have not offered significant amounts of this category of loans.

### *The Regressors*

Thirteen model regressors (table 1) were chosen to reflect the supply and demand factors affecting  $Y^*$ . These regressors included five bank variables, six agricultural variables and two general variables. The five bank variables included in the model, designed to capture factors affecting a bank's allocation of investable funds among competing investment opportunities, are: the bank's deposit composition, the level of competition faced by the bank, its organizational structure (specifically its association with a multi-bank holding company),

location, and equity base. The six agricultural variables included in the model are: farm profitability, farm risk, value of farmland and buildings, size of farming community, ownership of farmland, and the level of farm mechanization. These variables affect the degree to which agriculture attracts investable funds from commercial banks. The variables population and oil production were also included in the study because they are expected to affect the demand and availability of commercial banks' investable funds. Each variable is discussed below.

### *Deposit Structure*

A ratio of a bank's time and savings deposits to total deposits (DEPOSIT) was used to represent the proportion of total deposits that are sensitive to interest rate changes. It can be argued that there is a positive relationship between DEPOSIT and loans in general because time and savings deposits enhance the stability of loanable funds. Therefore, banks need less liquidity and can invest more money in loans. It can also be argued that there is a negative relationship. Deposits are more interest rate sensitive and banks may choose to increase investments in interest rate sensitive assets and to decrease investments in loans. Banks may choose to invest in more investment securities like U.S. treasury securities because their interest rate movement more closely matches the interest rate movements on deposits, thus, reducing interest rate risk. This may especially be true in the post-deregulation era that is characterized by volatile interest rates. Banks could use adjustable interest rates on loans to make them more sensitive to interest rate movements. However, repricing a loan can result in additional transaction costs to the bank and transferring risk to a borrower may increase the likelihood of a loan default. It is not clear which effect overshadows the other. Thus, the sign on the estimated coefficient is indeterminate *a priori*.

### *Competition*

The competition faced by an individual bank in a certain community or sector (e.g., agriculture) should affect its investment decisions. This is particularly true if there are specialized lenders. The major competitor of commercial banks

Table 1. Explanatory Variables in the Tobit Model

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DEPOSIT	=	ratio of a bank's time and savings deposits to total deposits.
COMPETITION	=	an index that measures the amount of competition a bank faces in its market area for agricultural loans.
MBHC	=	binary variable: 1 if a bank belongs to a multi-bank holding company.
URBAN	=	binary variable: 1 if a bank is located in a metropolitan statistical area
EQUITY	=	ratio of a bank's total equity to its total assets.
PROFIT	=	ratio of net cash income from farm sales to total farm assets in each county.
RISK	=	ratio of the coefficient of variation of farm income to the coefficient of variation of total income in each county.
LAND	=	value of land and buildings (\$1,000/acre, average) in each county.
INCOME	=	ratio of farm income to total income in each county.
OWNER	=	ratio of the number of farmers operating their own land to the total number of farmers in each county.
MACHINE	=	estimated market value of all machinery and equipment in the county (\$ million).
POPULATION	=	population in each county (1,000's)
OIL	=	amount of oil produced in each county in 1987 (barrels).

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in the nonreal estate farm loan market is Production Credit Associations (PCAs). A commercial bank is likely to allocate less money to agriculture relative to its total assets in areas where PCAs and other competing commercial banks are very active. The number of alternative credit sources in the community has previously been used as a proxy for competition (Barkley et al.). However, this does not consider the size of the competitors. In this study, the proxy for bank competition was based on the volume of assets of its competitors in its market. A bank's market area was delineated by county boundaries. Although this might not be true in all cases, it has been found a reasonable assumption under conditions where the study does not focus on local market characteristics and the flow of funds (Barry and Pepper; Gilbert). A competition index was computed that consisted of PCA assets and total assets of the commercial banks operating in the same county. The proxy for competition faced by a bank was computed as

$$\text{competition index}_j = 1 - \frac{\text{bank assets}_j}{\text{total assets}}, \quad (7)$$

where the *competition index* (COMPETITION) is a measure of the amount of competition faced by the *j*th bank in its market area, with 0 denoting lack of competition and 1 denoting maximum competition; *bank assets* refer to the total assets of the *j*th bank; and *total assets* refer to all the combined assets of PCAs and commercial banks operating in the county.

#### *Multi-Bank Holding Company (MBHC) Affiliation*

Barry and Pepper contend that bank holding company affiliation in general provides banks with greater lending capacity, more competitive behavior, stronger risk bearing, more flexible funds acquisition, and deeper service capacity. Thus, MBHC affiliation should contribute positively to the availability of credit services offered by smaller banks to agriculture. Following this reasoning, a positive relationship would be expected between MBHC affiliation and the agricultural loan to asset ratio, reflecting the affiliate's greater capacity to generate loanable

funds, to meet large loan requests, to have more specialized personnel, and to provide credit-related services. However, MBHC affiliates might also have more diverse clients and investment opportunities that might compete for their loanable funds resulting in reduced agricultural lending relative to total assets. A dummy variable was defined, with a 1 for multi-bank holding company affiliation and 0 otherwise. It is not possible, *a priori*, to determine the sign of the estimated coefficient.

### Urban

Urban banks (URBAN), defined as those banks located in a standard metropolitan statistical area, have more diverse clients and thus have more flexibility in moving in and out of agriculture. Moreover, rural banks are more likely to lend more money to agriculture relative to their assets than urban banks because rural banks are more dependent on the agricultural economy. Thus, a negative estimated coefficient would be expected for urban banks.

### Equity

An important function of bank capital is to reduce risk. Koch discusses three ways in which this is achieved. First, it provides a cushion for firms to absorb losses and remain solvent. Second, it provides ready access to financial markets and thus guards against liquidity problems caused by deposit outflows. Third, it constrains growth and limits risk taking. A well-capitalized institution is in a better position to take on risk by investing more in loans and less in safe assets like government securities. Its large equity base would cushion the institution against large loan losses. However, the decision makers of less capitalized institutions may choose a similar investment strategy to increase expected profits, although at a greater risk. It is consistent with this risk/return preference for them to invest in more risky assets such as loans because of their higher expected returns. Thus, the estimated coefficient of the equity variable, which was defined as the ratio of the bank's total equity to its total assets (EQUITY), is indeterminate.

### Farm Profitability

A firm that is achieving a high rate of return on its assets can increase the return to equity by increasing its leverage, as long as the rate of return on assets exceeds the rate of interest paid on farm debt (Collins). Thus, farmers in a county with profitable farming operations would demand more agricultural loans. Similarly, banks in such a county would be willing to commit a higher proportion of their asset portfolio to agricultural loans because of the reduced likelihood of loan defaults by the farm borrowers. This variable, which was defined as the ratio of net cash income from farm sales to total farm assets in each county (PROFIT), is expected to have a positive coefficient.

### Farm Risk

The ratio of the coefficient of variation of farm income to the coefficient of variation of total income in each county (RISK) was used as a measure of farm risk. It is expected that counties with higher farm risk would attract less agricultural lending from commercial banks. Thus, the estimated coefficient should be negative.

### Value of Farmland and Buildings

A lender can reduce the likelihood of loan losses by requiring that land be used as collateral on nonreal estate loans. A farm located in an area with high farmland and property values will likely have a higher collateral value. Higher collateral values support higher levels of debt. The property value was standardized across communities by dividing the total value of farmland and farm buildings in a county by the total acres of farmland (LAND).

An area with high farm property values, however, may also be in an area that offers greater nonagricultural business opportunities. In fact, such areas will likely be located near commercial and industrial centers. These commercial and industrial businesses (and consumers in the communities) will compete for bank loans. Thus, agricultural loan portfolios of commercial banks in these areas may be smaller. Therefore, the sign of the estimated coefficient is indeterminate, *a priori*.

### *Size of Farming Community*

Banks located in predominantly agricultural communities will likely obtain a large percentage of their deposits from farm firms. To cultivate a strong bank-borrower relationship, these banks are likely to lend a greater proportion of their investable funds to the local farming community. Moreover, there is a feedback effect, by which a thriving local community will increase the deposits, providing more loanable funds for the bank. However, specializing in agriculture can lead to financial difficulties for the bank in case of an economic downturn in the local economy. The ratio of farm income to total income in each county (INCOME), which was used as a proxy for the size of the farming community, is expected to have a positive estimated coefficient.

### *Ownership of Farmland*

It is likely that owner-operators would be interested in developing and maintaining a more long term relationship with their lenders than tenant farmers. Thus, in general, lending to an owner-operator would be less risky than lending to a tenant farmer because owner-operators would likely have a longer farming history and loan collateral on land. In fact, several credit scoring studies have found land ownership to be an important factor in discriminating between potentially good agricultural loans and bad loans (Dunn and Frey; Lufburrow, Barry and Dixon; Reinsel). However, there are other important credit factors such as management ability, repayment ability, and borrower integrity, factors that are not unique to owner operators. Moreover, tenant farmers may not have as much equity capital as owner-operators and may require more nonreal estate financing. The ownership of farmland variable, defined as the ratio of the number of farmers operating their own land to the total number of farmers in each county (OWNER), is expected to have a positive estimated coefficient.

### *Level of Farm Mechanization*

Counties with more mechanized operations are assumed to require more debt capital to finance equipment and operating expenses. Thus, this variable, defined as the estimated market value of all machinery and equipment in the county

(MACHINE), is expected to have a positive estimated coefficient.

### *Population*

Population was used as a proxy for consumer loan demand in each county. Nonfarm population is expected to provide deposits to commercial banks, thus, providing banks with additional loanable funds. However, the nonfarm population will also compete with farmers for these loanable funds. Thus, the expected sign of the estimated coefficient is indeterminate *a priori*.

### *Oil Production*

An economy strengthened by increased oil revenue benefits agriculture as a whole, much as an economy weakened by a loss of oil revenue hurts agriculture. Besides providing loanable funds, oil revenues also affect the purchasing power of those who depend on agriculture for food and fiber. However, this model was not designed to capture these interrelationships. It is easy to predict the effect of an oil boom or burst on the general economy of a given state, but it is more difficult to assess its impact on a local farming community. Oil production will stimulate the local economy directly from employment and oil producing business activities, and indirectly from oil profits retained in the community. The increase in economic activity may lead to an increase in local deposits, thus increasing banks' loanable funds. However, the increase in economic activity will likely increase loan demand for working capital, expansion of nonagricultural businesses, and consumer loans that compete with agricultural loans. The estimated coefficient is, therefore, indeterminate *a priori*.

### *Data Sources*

Data on bank variables were obtained from the FDIC call reports on condition and income, and agriculture data came from the *Census of Agriculture* (USDA, 1978 and 1987). Population and per capita income figures came from the *Local Area Personal Income*<sup>8</sup> publications of the U.S. Department of Commerce, and oil production figures came from the *Railroad Commission of Texas*. Loan information for each PCA was

obtained directly from personnel at the Farm Credit Bank of Texas. It was estimated that loans were 80 percent of total PCA assets. Total PCA assets were apportioned among counties by assigning weights to assets based on the value of farm output per county relative to the total value of farm output in the PCA area.

## Results

### *Summary Statistics*

Rural banks invested an average of 11 percent of their assets in nonreal estate agricultural loans (agricultural loan portfolio) in 1978 (table 2). However, this percentage dropped to 7.6 percent for rural independent banks and 6.6 percent for MBHC affiliates in 1987. Urban banks have experienced similar, but less dramatic, decreases as well. Part of this drop may be traced to deregulation, particularly to the high levels of interest rate sensitive deposits that have characterized the post deregulation era. However, there have also been some important changes in the agricultural and banking sector over this period.

Rural independent banks held fewer time and savings deposits to total deposits (55 percent) in 1978, than rural MBHC affiliates (58 percent) (table 2). These ratios rose to 83 percent and 84 percent respectively, in 1987. Urban banks held 57 percent of their deposits in time and savings deposits in 1978, and 82 percent in 1987. This important increase in interest sensitive deposits likely increased the banks' cost of funds and its volatility, which in turn influenced the asset allocation decisions made by each bank.

Average bank equity ratios in 1978 ranged from a low of 7.3 percent (Urban MBHC affiliates) to a high of 8.9 percent (Rural Independent) (table 2). After deregulation, equity ratios decreased by 1.9, 1.2, and 0.4 percentage points for urban and rural MBHC affiliates, and urban independents, respectively. Capital increased by 0.4 percentage points for rural independent banks.

A summary of bank competition as, defined in equation (7), is presented in table 3 with well

over half the banks in the sample facing a high level of competition in their market, i.e., had a competition index of 75 percent or more. Although the level of competition faced by Texas banks did not change much since deregulation, individual banks may have experienced a change in competition.

The average county PROFIT was 2.3 percent in 1987 (table 4).<sup>3</sup> Data for net cash return from farm sales were not available for computing PROFIT for 1978. The county average RISK increased from 66.4 percent before deregulation to 67.5 percent after deregulation, LAND from \$464 per acre to \$706 per acre, INCOME from 9.3 percent to 9.9 percent, OWNERS from 51.9 percent to 56.6 percent, MACHINE from \$17.7 million to \$22.5 million, and POPULATION from 53,141 people to 66,054 people. OIL decreased from 4.1 million barrels to 2.9 million barrels. As expected, there were many differences between counties as measured by the standard deviation.

### *Estimated Structural Coefficients*

The estimated tobit coefficients are presented in table 5. Columns two and three show the coefficients and their asymptotic t-ratios. Except MACHINE, all the estimated coefficients were statistically significant at the 5 percent level. Column four shows the change in probability of making agricultural loans due to a unit change in each independent variable. Columns five and six show the two components of a total change in  $E[Y]$ , given a change in each independent variable. Column five represents the change in  $E[Y]$  for those banks that are already making agricultural loans, weighted by the probability of making agricultural loans. Column six represents the change in probability of making agricultural loans, weighted by the conditional expected value of making agricultural loans  $E[Y^*]$ .  $F(z)$  denotes the cumulative standard normal distribution function. The estimated equation was statistically significant.<sup>4</sup> Table 6 contains tobit elasticities computed with equations (4), (5), and (6). The elasticities of agricultural lending from banks already making agricultural loans were only slightly higher than for those banks that would begin or stop making agricultural loans.



Table 2 Descriptive Statistics for Banks Included in the Study

Variable	Location	Before Deregulation (1978)				After Deregulation (1987)			
		Independent		MBHC - Affiliates*		Independent		MBHC - Affiliates*	
		Standard		Standard		Standard		Standard	
		Mean	Deviation	Mean	Deviation	Mean	Deviation	Mean	Deviation
Sample									
Banks (No ) <sup>b</sup>	Rural	496	N/A <sup>c</sup>	39	N/A	414	N/A	133	N/A
	Urban	384	N/A	134	N/A	218	N/A	288	N/A
[Y'] <sup>d</sup>	Rural	0.112	0.108	0.112	0.102	0.076	0.089	0.066	0.089
	Urban	0.036	0.060	0.011	0.030	0.020	0.031	0.009	0.022
DEPOSIT <sup>e</sup>	Rural	0.549	0.132	0.582	0.091	0.832	0.099	0.848	0.083
	Urban	0.573	0.101	0.569	0.065	0.816	0.061	0.820	0.062
EQUITY <sup>e</sup>	Rural	0.089	0.024	0.088	0.022	0.093	0.041	0.076	0.025
	Urban	0.080	0.019	0.073	0.015	0.076	0.030	0.054	0.030

<sup>a</sup> Banks that are affiliated with multi-bank holding companies (MBHC)  
<sup>b</sup> There are 1,053 banks included in this study.  
<sup>c</sup> Not applicable.  
<sup>d</sup> Ratio of outstanding nonreal estate agricultural loans to total bank assets  
<sup>e</sup> Complete definitions are presented in table 1.

Table 3. Frequency Distribution of Competition Faced by Sample Banks, 1978 and 1987

Competition Category <sup>a</sup>	Frequency (Number of Banks)	
	1978	1987
0.00 - 0.25	29	31
0.26 - 0.50	68	70
0.51 - 0.75	226	217
0.76 - 1.00	730	735

<sup>a</sup> A 0 denotes no competition and 1 denotes maximum competition. See equation (7) for details on the computation of the competition index.

Deposit Structure

The estimated negative coefficient implies that some decrease in agricultural loan portfolios since deregulation can be explained by the increase in interest sensitive deposits held by banks (table 2). A 1 percent increase in DEPOSIT results in a 0.85 percent decline in agricultural loan portfolios (table 6). Approximately 0.42 percentage points of the 0.85 percent decline in agricultural loan portfolios is from banks that stop lending to agriculture.

Competition

A 1 percent increase in COMPETITION results in a 0.37 percent decrease in the proportion of agricultural loans in banks' asset portfolios, with about half coming from banks that would stop making agricultural loans (table 6). Bank competition has not changed much since deregulation (table 3), thus, COMPETITION does not explain the decrease in agricultural loan portfolios. In rural areas, much of the competition

**Table 4.** County Summary Statistics for the Non Bank Variables Used in the Tobit Model, 1978 and 1987, (Number of Counties = 254)<sup>a</sup>

Variable	1978		1987	
	Mean	Standard Deviation	Mean	Standard Deviation
PROFIT	--- <sup>b</sup>	--- <sup>b</sup>	0.023	0.030
RISK	0.664	0.284	0.675	0.194
LAND	0.464	0.262	0.706	0.478
INCOME	0.093	0.105	0.099	0.133
OWNER	0.519	0.137	0.566	0.126
MACHINE	17.678	15.237	22.452	15.665
POPULATION	53.141	191.280	66.054	239.050
OIL	4.099	10.513	2.854	6.641

<sup>a</sup> Variable name definitions are presented in table 1. Dollar values are in nominal terms.<sup>b</sup> Not Available**Table 5.** Summary Statistics for Tobit Analysis of the Demand and Supply of Agricultural Lending in Texas, 1987

Variable	$\beta$	Asymptotic t-ratio	$\left[ \frac{\partial F(z)}{\partial X} \right]^a$	$\left[ \frac{\partial E[Y^*]}{\partial X} F(z) \right]^b$	$\left[ \frac{\partial F(z)}{\partial X} E[Y^*] \right]^c$
DEPOSIT	0.0648 <sup>d</sup>	-2.61	-0.3646	-0.0229	-0.0222
COMPETITION	-0.0286 <sup>d</sup>	-2.43	-0.1641	-0.0103	-0.0100
MBHC	-0.0112 <sup>d</sup>	-2.64	-0.0401	-0.0025	-0.0024
URBAN	-0.0229 <sup>d</sup>	-4.26	-0.1426	-0.009	-0.0087
EQUITY	-0.1496 <sup>d</sup>	-2.56	-0.8261	-0.0519	-0.0503
PROFIT	0.5163 <sup>d</sup>	4.81	2.9687	0.1865	0.1808
RISK	-0.0287 <sup>d</sup>	-2.21	-0.1670	-0.0105	-0.0102
LAND	-0.0198 <sup>d</sup>	-2.85	-0.0898	-0.0056	-0.0055
INCOME	0.2391 <sup>d</sup>	7.77	1.3974	0.0878	0.0851
OWNER	-0.1038 <sup>d</sup>	-4.14	-0.6138	-0.0386	-0.0374
MACHINE	0.2765	1.74	1.6536	0.1039	0.1007
POPULATION	-0.0146 <sup>d</sup>	-3.67	-0.0850	-0.0053	-0.0052
OIL	-0.0013 <sup>d</sup>	-3.86	-0.0076	-0.0005	-0.0005
CONSTANT	0.2163 <sup>d</sup>	7.08	1.2577	0.0790	0.0766

<sup>a</sup> Change in the probability of making agricultural loans due to a change in the corresponding independent variable.<sup>b</sup> Change in  $E[Y^*]$  for those banks already making agricultural loans, weighted by the probability of making agricultural loans.<sup>c</sup> Change in the probability of making agricultural loans, weighted by the conditional expected value of making agricultural loans  $E[Y^*]$ .<sup>d</sup> Significant at the 5 percent level.Note: The standard error around the Tobit index is 0.0580. The predicted probability that  $Y > 0$ , at the mean of  $X$ , is 0.7191, and Theil's goodness-of-fit statistic is 0.3762.

**Table 6.** Calculated Elasticities from Tobit Coefficients for Agricultural Lending in Texas, 1987

Variable	$\eta E[Y]$	$\eta E[Y^*]$	$\eta F[z]$
DEPOSIT	-0.8528	-0.4330	-0.4198
COMPETITION	-0.3748	-0.1903	-0.1845
MBHC	-0.0816	-0.0414	-0.0402
URBAN	-0.1938	-0.0984	-0.0954
EQUITY	-0.1794	-0.0911	-0.0883
PROFIT	0.1410	0.0716	0.0694
RISK	-0.3007	-0.1527	-0.1480
LAND	-0.2816	-0.1430	-0.1386
INCOME	0.1897	0.0963	0.0934
OWNER	-1.0494	-0.5328	-0.5166
MACHINE	0.1364	0.0693	0.0672
POPULATION	-0.0986	-0.0501	-0.0485
OIL	-0.0581	-0.0295	-0.0286

<sup>a</sup> The elasticity of unconditional agricultural lending (equation (4)). Note that  $\eta E[Y] = \eta E[Y^*] + \eta F$ .

<sup>b</sup> The elasticity of agricultural lending from banks making agricultural loans (equation (5)).

<sup>c</sup> The elasticity of agricultural lending from banks that begin or quit making agricultural loans (equation (6)).

faced by commercial banks comes from PCAs. Thus, the future of PCAs, and the Farm Credit System as a whole, will have an impact on the extent to which rural banks participate in agricultural lending. Reduced PCA activity would lead to increased commercial bank participation in agricultural lending, *ceteris paribus*. Conversely, increased PCA activity would lead to less commercial bank participation in agricultural lending.

#### Multi-Bank Holding Company Affiliation

Results showed that the coefficient for MBHC was negative and statistically significant (table 5). Holding everything else constant, agricultural loan ratios for MBHCs would be 1.1 percent lower than independent banks. This corresponds to \$1.1 million of agricultural loans for a bank with \$100 million in assets. MBHC affiliates increased from 16.5 percent of the total number of commercial banks in Texas before deregulation to 40 percent after deregulation (table 2). Thus, part of the decrease in agricultural loan ratios over this period can be attributed to the increase in MBHC affiliates after deregulation.

Moreover, the recent proposals by the Treasury Department to revise banking laws may decrease agricultural loan portfolios further if they encourage an increase of MBHCs.

#### Urban

It was estimated that a rural bank with \$100 million dollars in assets was lending an average of \$2.3 million more to agriculture than a similar urban bank (table 5). A comparison of the estimated coefficients for MBHC affiliation and location reveals that location plays a bigger role than MBHC affiliation in determining the level of the agricultural loan portfolio.

#### Equity

The negative equity coefficient suggests that less capitalized banks had more agricultural loans relative to their assets than more capitalized banks (table 5). As explained above, less capitalized banks may have assumed more risk by investing proportionately more of their assets in loans that have higher expected return and a higher risk. If successful, this strategy would result in

greater profits relative to the capital committed. However, the negative relationship could be a reflection of the poor performance of the agricultural sector in the early 1980's. Banks making agricultural loans could have incurred heavy loan losses eroding the loan loss reserves of these institutions.

### *Farm Profitability*

As expected, results show that communities with more profitable farming operations attract more agricultural loans than communities with less profitable farming operations (table 5). Thus, part of the observed decline in agricultural loan portfolios at Texas commercial banks since deregulation was a reflection of the declining performance of the agricultural sector in Texas in the 1980's relative to the 1970s. A 1 percent decrease in PROFIT results in a 0.14 percent decrease in agricultural loan portfolios (table 6).

### *Farm Risk*

In counties where farm income is relatively more volatile than nonfarm income, less money is lent to agriculture compared to other investment opportunities (table 5). A 1 percent increase in RISK results in a 0.30 percent decrease in agricultural loan portfolios (table 6). Thus, part of the observed decline in the agricultural loan portfolios at commercial banks since deregulation was a result of the increased risk in production agriculture (table 4).

### *Value of Farm Land and Buildings*

Results show that a 1 percent increase in LAND decreases agricultural loan portfolios by 0.28 percent (table 6). A possible explanation for this unexpected result is the high valued property's proximity to urban centers, where nonagricultural activities are likely to compete more favorably for bank investments.

### *Size of Farming Community*

The positive estimated coefficient of the proxy for the importance of agriculture in a county is expected because a bank located in a predominantly farming community depends on

agriculture for borrowers and on farm related income for its deposits (table 5). However, INCOME did not increase much after deregulation, offering little explanation for the decline in bank agricultural loan portfolios (table 4).

### *Ownership of Farm Land*

The negative estimated coefficient suggests that owner-operators borrow less nonreal estate debt from banks than tenant farmers (table 5), contrary to the previously stated hypothesis that land ownership corresponds to high agricultural loan ratios. A possible explanation is that tenant farmers on the average have less equity capital, thus requiring greater financing of operating expenses and machinery. It is also possible that the owner-operators that obtain their land loans from the Federal Land Bank may also obtain nonreal estate loans from PCAs. This result may also be data specific. Nonreal estate debt is reported as a real estate debt in the FDIC call reports when land is used as collateral. Thus, nonreal estate debt may be under-reported for owner-operators.

### *Level of Farm Mechanization*

The estimated coefficient of farm machinery was not statistically significant, although it had the expected positive sign (table 5), suggesting little correlation between the level of agricultural loan portfolios at commercial banks, and the value of farm machinery in the respective communities.

### *Population*

The more populated counties attracted money away from agriculture, with a 1 percent increase in POPULATION resulting in a 0.10 percent decrease in agricultural loan portfolios (table 6).

### *Oil Production*

The results suggest that agriculture was not a major beneficiary from "petro-dollars" in oil producing counties. A 1 percent decrease in OIL results in a 0.06 percent decrease in agricultural loan portfolios (table 6).

## Summary and Conclusions

A tobit econometric procedure was used to examine the effect of selected demand and supply factors on the proportion of agricultural loans in commercial bank asset portfolios. In particular, the impact of increased commercial bank reliance on interest sensitive deposits after deregulation on funds that banks allocate to agriculture relative to other investment opportunities was examined. Also, independent banks were compared to multi-bank holding company affiliates to determine the impact of bank organization on the share of agricultural loans in bank asset portfolios.

Results show that as commercial bank deposits become more sensitive to market rates, the proportion of agricultural loans relative to

commercial bank assets decline. A 1 percent increase in the ratio of time and savings deposits to total deposits was associated with 0.85 percent decline in the ratio of agricultural loans to total assets, with almost half of this decline coming from banks that would stop making agricultural loans. Also, banks affiliated with multi-bank holding companies lend less money to agriculture relative to their assets than do nonmulti-bank holding company affiliates. Thus, as multi-bank holding company affiliates continue to increase (e.g., through acquisitions of failed institutions by existing banking organizations or through voluntary mergers), there will be a reduction in agricultural loans provided relative to the volume of assets held by commercial banks, which could mean an absolute reduction in the total amount of loans available to the agricultural sector.

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## Endnotes

1. For some theoretical discussion see J. Tobin, T. Amemiya, and J. Heckman. For some applications, see J. Heckman, and J.G. Gragg. For a more recent application in the agricultural economics literature, see O. Capps Jr. and John M. Love.
2. Another common example of a limited dependent variable relates to the wages of married women since wages are recorded only for women who are in the labor force. Wages of women whose "reservation wage" exceeds their market wage and who, therefore, stay at home are recorded as zero. No distinction is made between women whose reservation wage barely exceeds their market wage and those whose reservation wage is much higher than their market wage. (J. Kmenta, p. 561).

3. The Agricultural Census Bureau derives the cash return from agricultural sales for the farm unit by subtracting operating expenditures from the gross market value of agricultural products sold. Depreciation and the change in inventory values are excluded from expenditures. Gross sales include sales by the operator and the share of sales received by partners, landlords, and contractors. This ratio does not include capital gains. Farm assets were defined as the sum of the market value of land and buildings, and the market value of machinery and equipment.

4. A test using the chi-square distribution replaces the usual F test to test the significance of all the coefficients in the tobit model when maximum likelihood is used. First, the likelihood function is evaluated when all parameters other than the constant are set to zero ( $L_0$ ). Next, the likelihood function at its maximum ( $L_{\max}$ ) is evaluated. The likelihood ratio test is constructed as  $-2(\log L_0 - \log L_{\max}) \sim \chi^2_p$  where  $p$  is the number of regressors in the statistical model.